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THE EFFECTIVENESS OF NEW TAILGATE SUPPORT METHODS AT LINGAN COLLIERY

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December 1985

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MICROMEDIA

21 pp

ENERGY RESEARCH PROGRAM
COAL RESEARCH LABORATORIES
DIVISION REPORT ERP/CRL 85-107(IR)

THE EFFECTIVENESS OF NEW TAILGATE SUPPORT METHODS AT LINGAN COLLIERY

by

S.D. Ross* and P. Cain**

SUMMARY

The purpose of this report is to compare and evaluate the conventional (9E) and new (6W) support methods at Lingan Colliery tailgates.

The tailgates of 9E and 6W are described and compared with respect to pack resistance and gateroad closure.

It was concluded from the results of the instrumentation sites that the new packing method controlled strata movement more effectively and achieved ideal pack resistance more rapidly than the conventional support method.

It is recommended that the gateroad design be further modified to eliminate the rib undercut and that another instrumentation site be installed to monitor the effects in the gateroad.

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EFFICACITÉ DES NOUVELLES MÉTHODES DE SOUTÈNEMENT DE LA VOIE DE TÊTE À LA HOUILLÈRE LINGAN

par

S.D. Ross* et P.Cain**

RÉSUMÉ

Ce rapport a pour objectif de présenter une comparaison et une évaluation des méthodes de soutènement classiques (9E) et nouvelles (6W) des voies de tête à la houillère Lingan.

Les voies de tête 9E et 6W sont décrites et comparées en fonction de la résistance du remblai et de la réduction de la voie de roulage.

D'après les résultats en provenance des sites de mesure, on a conclu que la nouvelle méthode de remblayage contrôlait les mouvements des couches géologiques de façon plus efficace et offrait un niveau de résistance optimum plus rapidement que la méthode de soutènement classique.

On recommande que la conception de la voie de roulage soit à nouveau modifiée afin de permettre l'élimination du pilier sous-cavé et qu'un autre site soit aménagé pour la surveillance des effets sur la voie de roulage.

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INTRODUCTION

Conventional tailgate packing at Lingan Colliery was not controlling strata movement. Convergence of the gateroad, as a result of strata movement, was disrupting activities in the tailgate. Conventional packing in the tailgate consisted of stone rubble with a 60% solid hardwood chock and three skeleton cribs.

The Cape Breton Development Corporation (CBDC) decided to implement a new support method. The new support consisted of larger arches and a continuous row of 1.5 x 1.5 m solid hardwood chocks. The Cape Breton Coal Research Laboratory (CBCRL) was asked to investigate the effects of the new support technique. This report describes the findings of investigations carried out in tailgates at Lingan Colliery: the conventional packed 9E Tailgate and the 6W Tailgate with the modified packing system. The effect of the packing change on pack resistance and gateroad closure are discussed.

DETAILS OF THE DISTRICTS

MINING PARAMETERS

Both the 9E and 6W Districts are advancing longwall coalfaces in the Harbour Seam at Lingan Colliery (Figure 1). Coal is extracted by a 224 kw Anderson Strathclyde double ended ranging drum shearer with a web of 0.68 m. Face supports are Hemscheidt 320 tonne two-leg shields. Additional mining parameters relating to each site are summarized in Table 1.

SUPPORT IN THE ROADWAY

Conventional tailgate packing at Lingan Colliery consisted of a 60% hardwood chock and three skeleton cribs, 0.75 m apart. Each row of four chocks was spaced 1.5 m apart. Between the chocks stone rubble from the rippings was shovelled. The final pack width was 6.0 m (Figure 2). In the 6W Tailgate a continuous row of 1.5 m x 1.5 m, 100% solid hardwood packs were built 4 - 5 m behind the faceline. Between the 1.5 m x 1.5 m pack and .75 m x .75 m skeleton crib was a 0.75 m space in which a brattice cloth was hung to seal the waste. The skeleton crib was built 3 - 4 m behind the advancing face, just behind the armoured face conveyor (Figure 2).

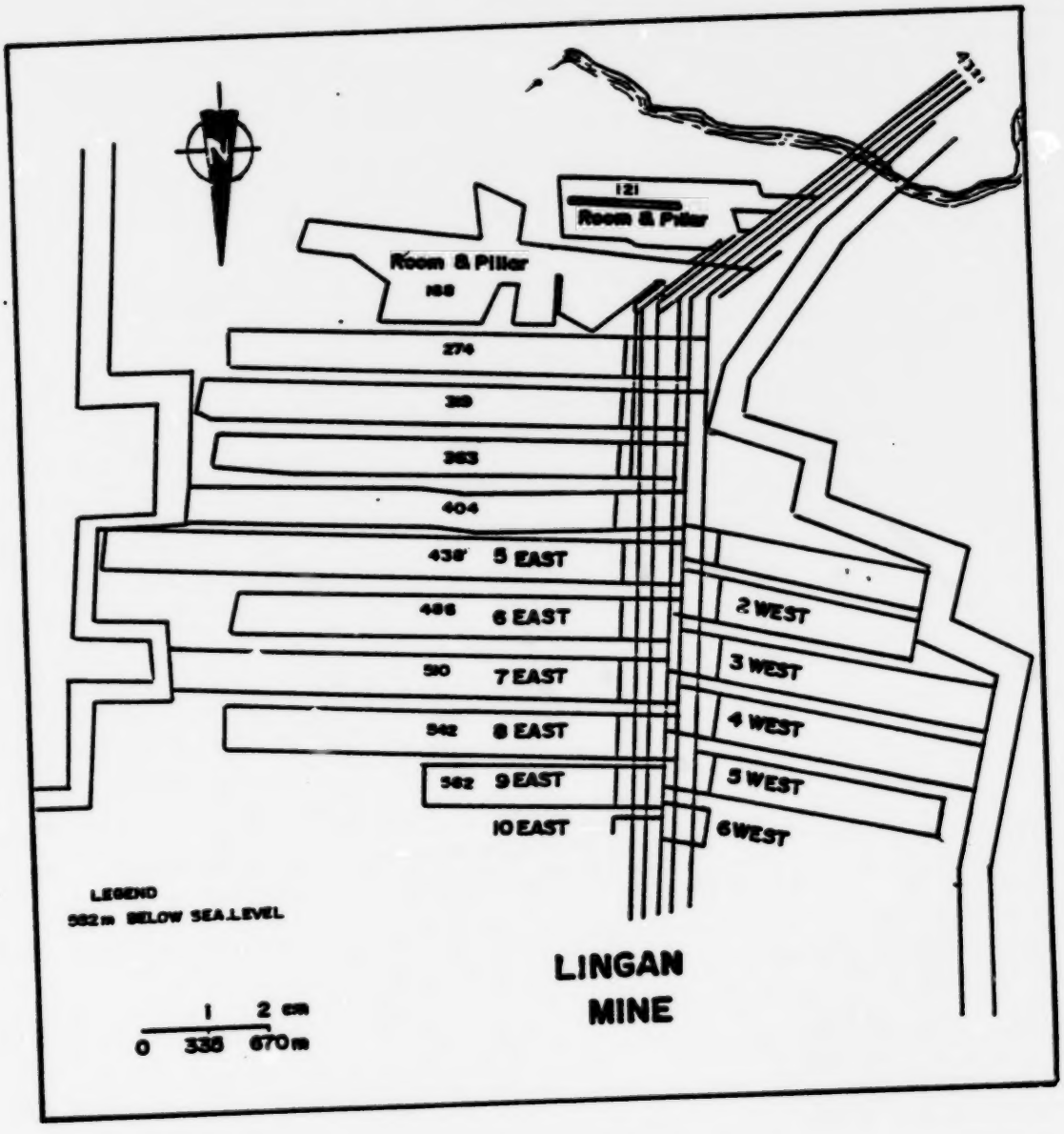

Figure 1 - Location Map

Legend

80 % fine to medium siltstone and 20% interbedded sandstone and siltstone

coal seam

silty mudstone seatearth

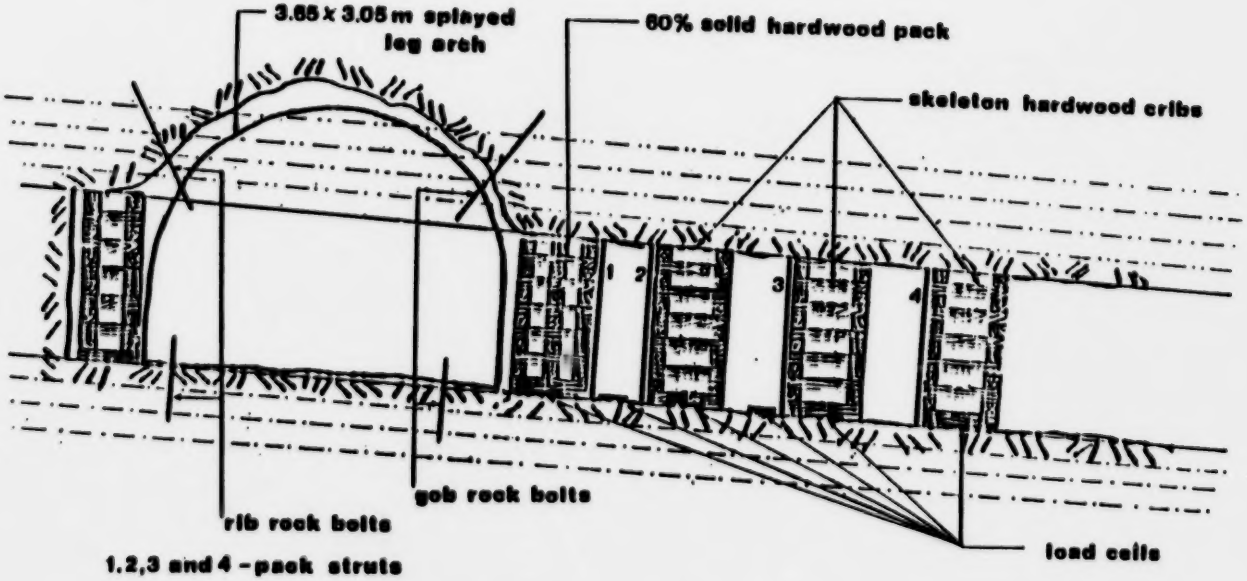

Figure 2 - Lithological and site cross-section of the 9E Tailgate at Lingan Colliery

Note - not to scale

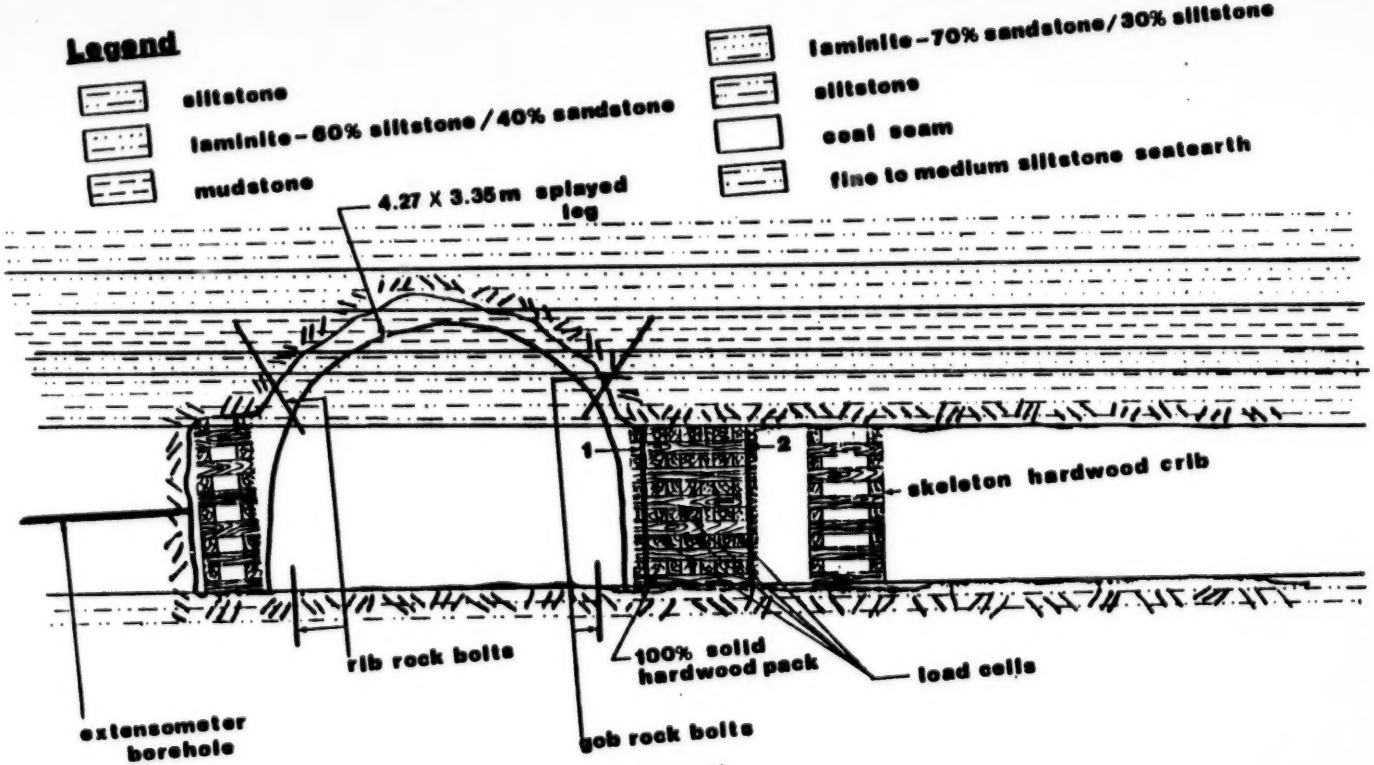

Figure 3 – Lithological and site cross-section of the 6W Tailgate at Lingan Colliery

Note – not to scale

The roadway support consisted of 120 mm x 90 mm I section steel. The new arches had a diameter of 4.27 m as opposed to 3.65 m diameter of the conventional arches. Each had 1.2 m splayed legs. The new steel section was 29.5 kg/m while the old steel section was 19.34 kg/m. Arches were set at 0.9 m intervals with eight 63 mm x 63 mm angle iron struts U-bolted to the arch. Drill and blast techniques were used to cut the roadways at a ripping 7 - 10 m behind the faceline.

ROADWAY GEOLOGY

The 6W Tailgate has been mapped along its length by the CBDC geological staff. A methane drainage borehole was logged 9 m away from the instrumentation site in 6W, so the lithology of the immediate roof was known. A generalized strata section was obtained from the CBDC staff for the 9E site. A cross-section of each site is given in Figures 2 and 3.

Both of the sites have a similar roof zone of fine to medium siltstone. The floor lithologies differ slightly with the 9E site having a silty mudstone seatearth as oppose to a siltstone seatearth at 6W.

DETAILS OF INVESTIGATION SITES

Two investigation sites were installed, one in the 9E Tailgate, the other in the 6W Tailgate. Information concerning depth of cover, extracted height and other parameters for both sites are given in Table 1.

Table 1 - Site parameters - 9E and 6W Tailgate, Lingan

Parameter	9E	6W
Depth of cover (m)	548	556
Extracted height	1.93	1.52
Pillar width (m)		
Maingate	Infinite	Infinite
Tailgate	61	64
Rate of face advance m/day	3.2	2.5

The investigation sites used a variety of instruments to monitor support load, closure and coal rib extrusion.

Table 2 - Instrumentation used in the investigation program

Parameter	Instrument
Closure: Packs	- Electronic resistance pack strut (Model COR/P-R, Roctest Inc., Montreal)
Closure: Gateroad	- Rockbolts in roof and floor
Load: Packs	- Earth pressure cell, hydraulic readout 0-1000 psi (Solinst Canada Ltd., Burlington)
Strata Movement	- Irad Gage Flexible Sonic Probe (Solinst Canada Ltd., Burlington)

INSTRUMENTATION SITES

To avoid production delays and unnecessary congestion at the face, both instrumentation sites were installed on a Saturday. Table 3 summarizes the instruments used the at 9E and 6W sites. A plan of each site is given in Figures 2 and 3.

Table 3 - Summary of instruments used at each investigation site

Site	Convergence Bolts	Load Cell Pack	Pack Strut
9E	two pairs, on rib and pack side	six load cells	four pack struts mounted in four different packs
6W	two pairs, on rib and gob side	six load cells mounted in 1.5 x 1.5 m, 100% solid hardwood pack	*two placed between packs

* Malfunctioned

In 6W an extensometer was installed into a hole drilled 4.6 m horizontally into the coal rib.

SITE MONITORING

Both sites were monitored daily for the first two weeks after installation. As the face advanced from the site, the monitoring frequency was reduced.

RESULTS

The convergence and pack load measurements compiled during the monitoring program are presented in Figures 4 to 9.

Results from each site indicate two distinct phases of strata movement. Phase 1 represents the immediate effects of the extraction of the coal, lasting until 30 - 60 m after the face was cut. Deformation then settles to a time dependant rate (Phase 2). Pack loads and closures at both tailgates rise rapidly in Phase 1 and then remain stable in Phase 2. This is typical of each phase.

The sites show loading and deformation patterns typical of those elsewhere. However, the larger rib side convergence in 6W was not typical of other sites. This closure may be a result of the undercutting of the coal to a distance of 1 - 1.5 m on the rib side. A continuous row of weak skeleton cribs set on unconsolidated coal duff supports the rib side.

Table 4 - Summary of results

		Time (days)	Average Load (MPa)	Rib Bolt Closure (cm)	Gob Bolt Closure (cm)
9E	Phase 1	0-20	1.01	5.4	29.9
	Phase 2	20-	0.98	3.4	2.4
6W	Phase 1	0-10	2.60	16.0	15.1
	Phase 2	10-	3.95	7.6	1.9

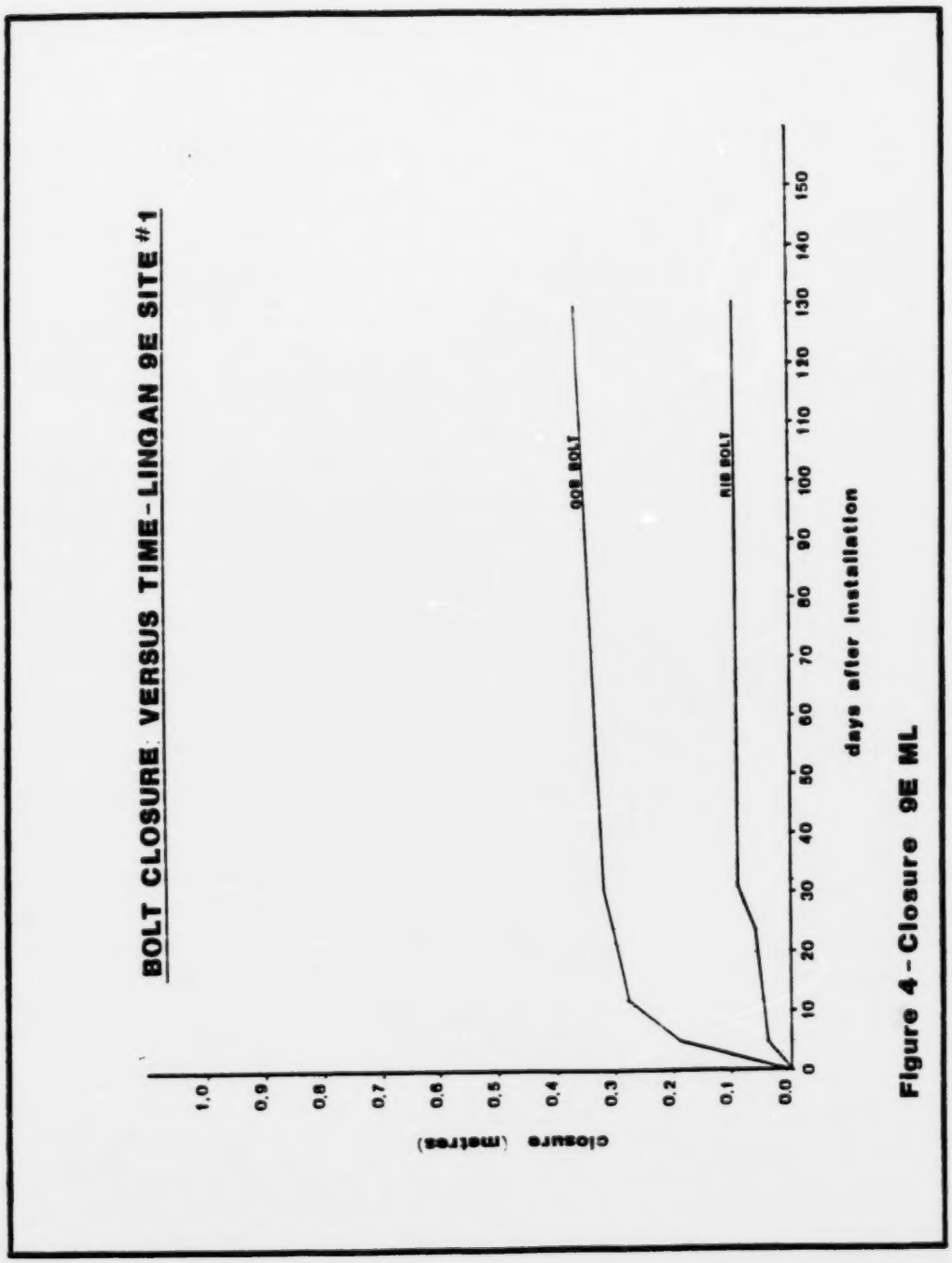

Figure 4 - Closure 9E ML

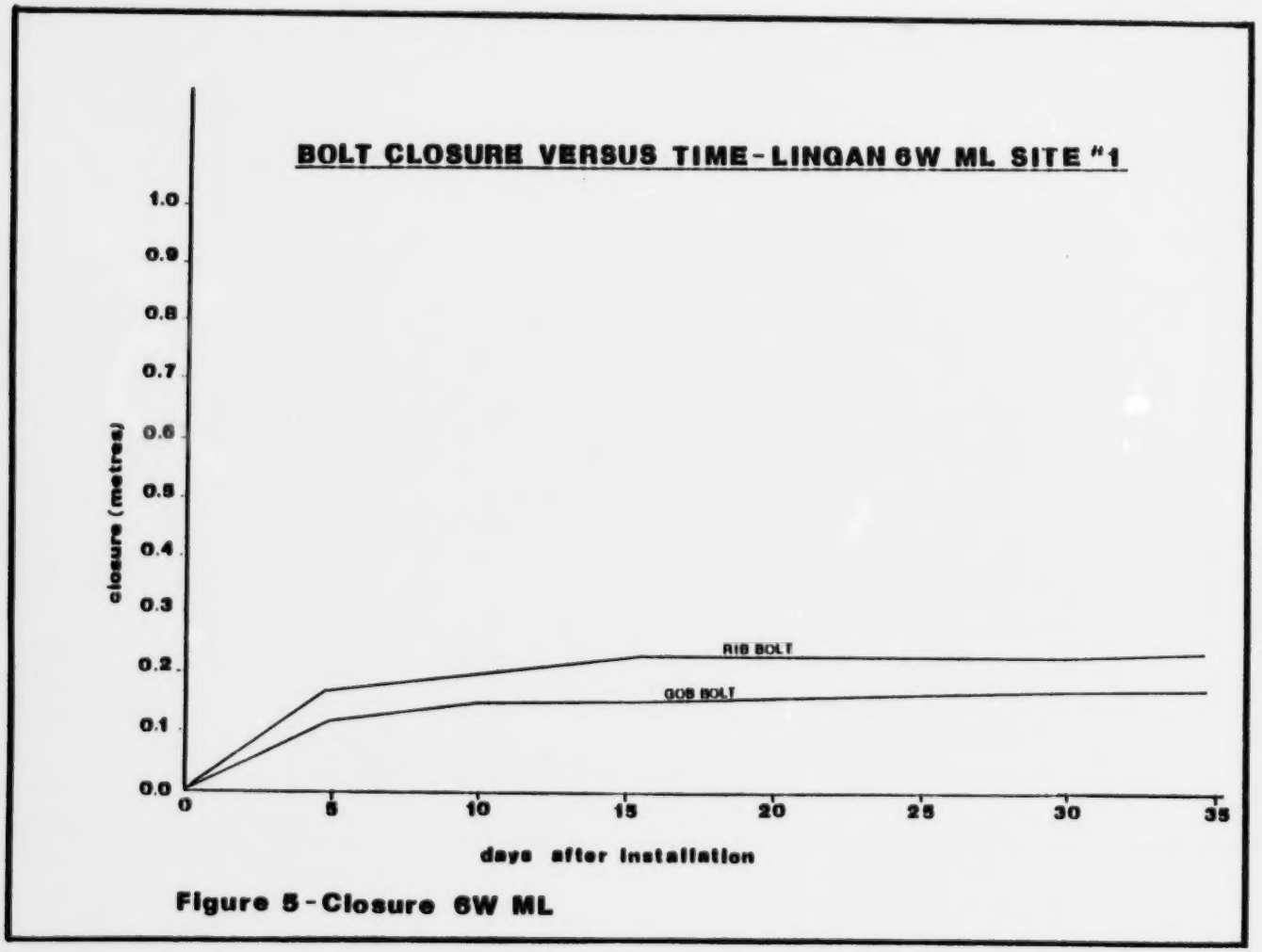

Figure 5 - Closure 6W ML

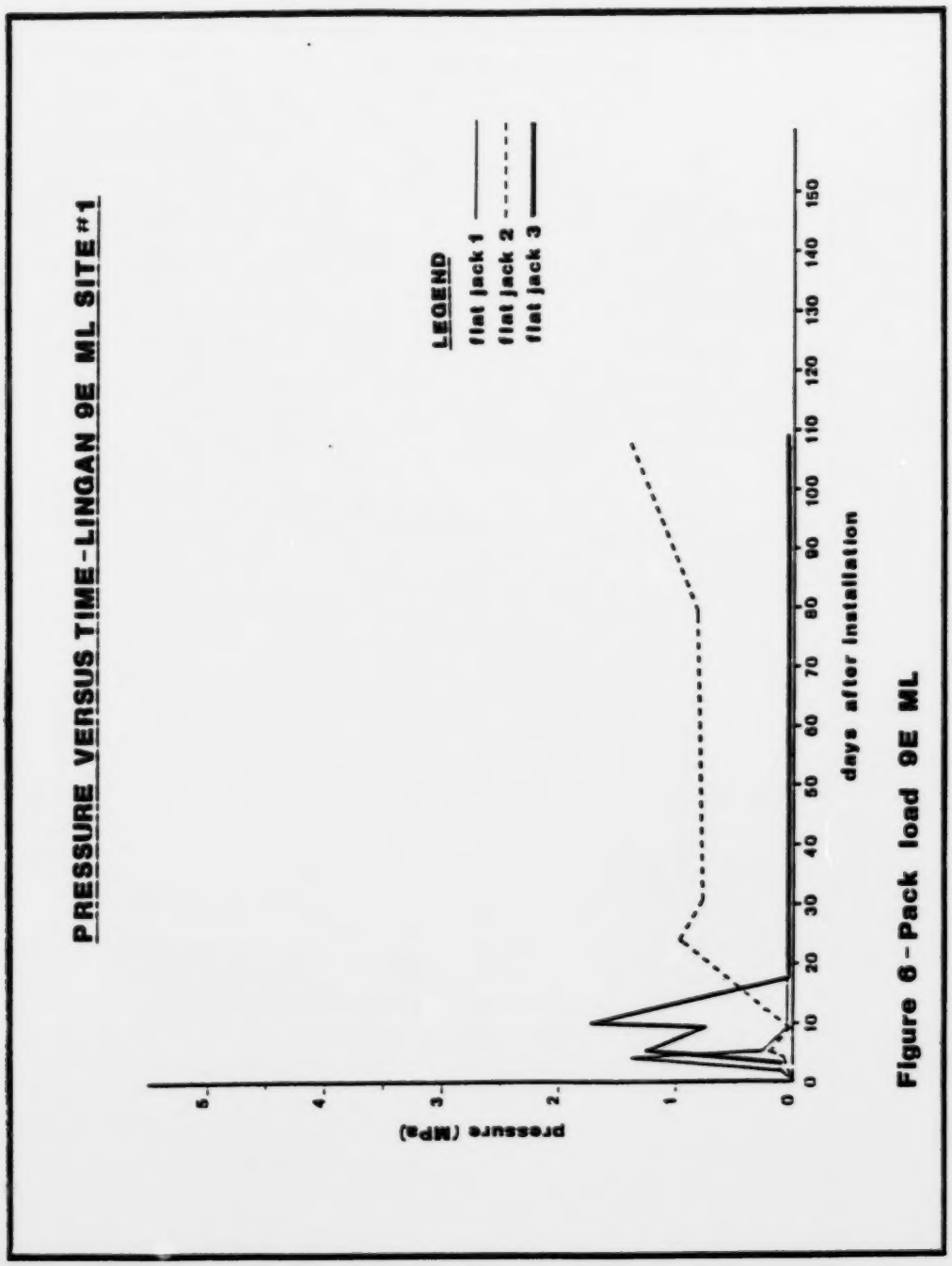

Figure 6-Pack load 9E ML

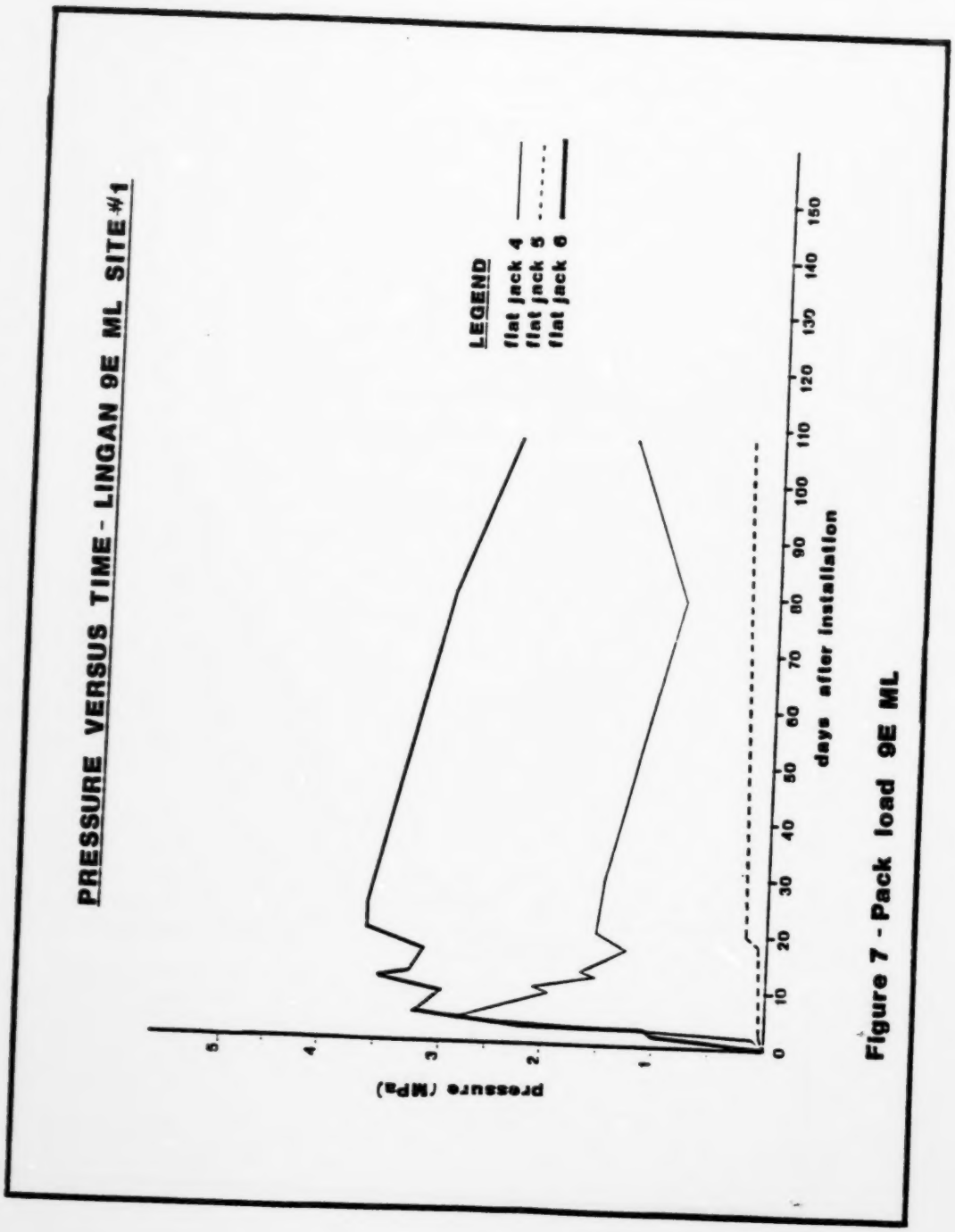

Figure 7 - Pack load 9E ML

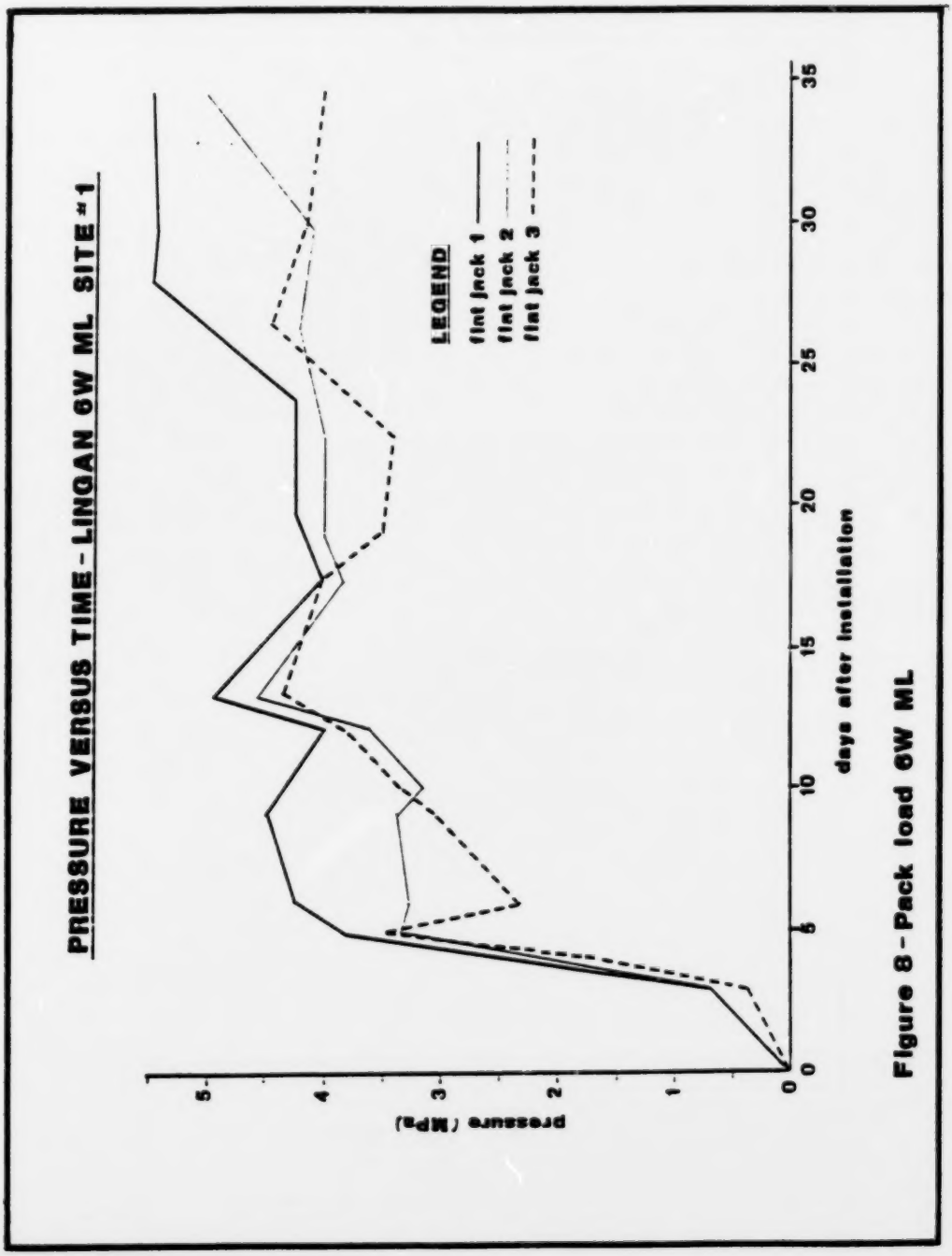

Figure 8 - Pack load 6W ML

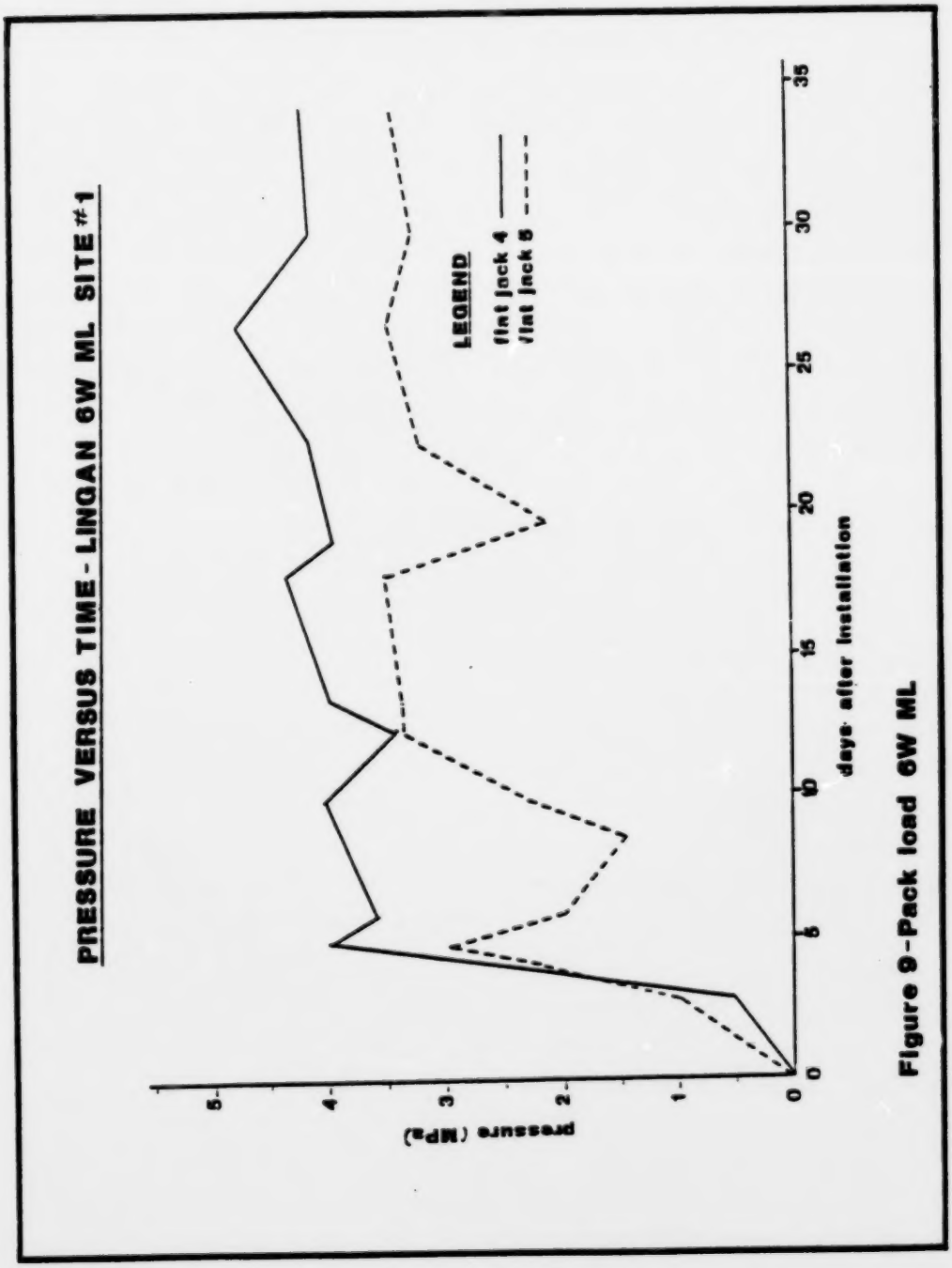

Figure 9-Pack load 6W ML

DISCUSSION

The 9E and 6W Tailgates were similar in geological setting and differ only in packing method and roadway support. The 9E and 6W steel supports had a weight per cubic metre volume of extracted roadway of 17.77 kg/m^3 and 24.11 kg/m^3 respectively. The 9E steel arch weighed 158.3 kg while the larger 6W arch was 272.1 kg. This is a significant increase in steel support. However, the support resistance of the steel arches is small (0.1 MN/m^2) when compared to the pack resistance. Therefore, the pack is the major component in controlling strata movement.

Roadway deformation was the main cause for concern in conventionally packed tailgates. The 9E and 6W sites had 12.6% and 5.1% closure respectively. The 50% reduction in closure of the gob side was a direct result of the new pack.

A computer programme, developed by CBCRL, was used to calculate pack resistances. The conventional pack obtained a resistance of 4.5 MN/m after 60 m face advance. The new pack resistance after 60 m face advance was 6.0 MN/m. Figure 10 shows a comparison of pack resistance development at each site. The new pack reaches peak resistance after 35 m face advance. The old pack type shows a very low pack resistance.

The larger arches made manual installation difficult. An Eimco 613 loader was brought into the tailgate to load the rippings. Previously stone rippings were shovelled by hand into the gob area. The physical effort of the men is less intensive with the Eimco present. The ripping area is also cleaner and less congested. The new packing system is faster to install than the conventional method and provides a more stable roadway. The stable roadway provides a safer working environment and makes ventilation of the district easier and therefore less expensive.

Since the new pack at 6W Tailgate was so successful at reducing roadway closure it is now being used at 9E Tailgate.

CONCLUSIONS

Closure was reduced more than 50% by the installation of the new packs and larger arches. The inadequacy of the support offered by the 9E

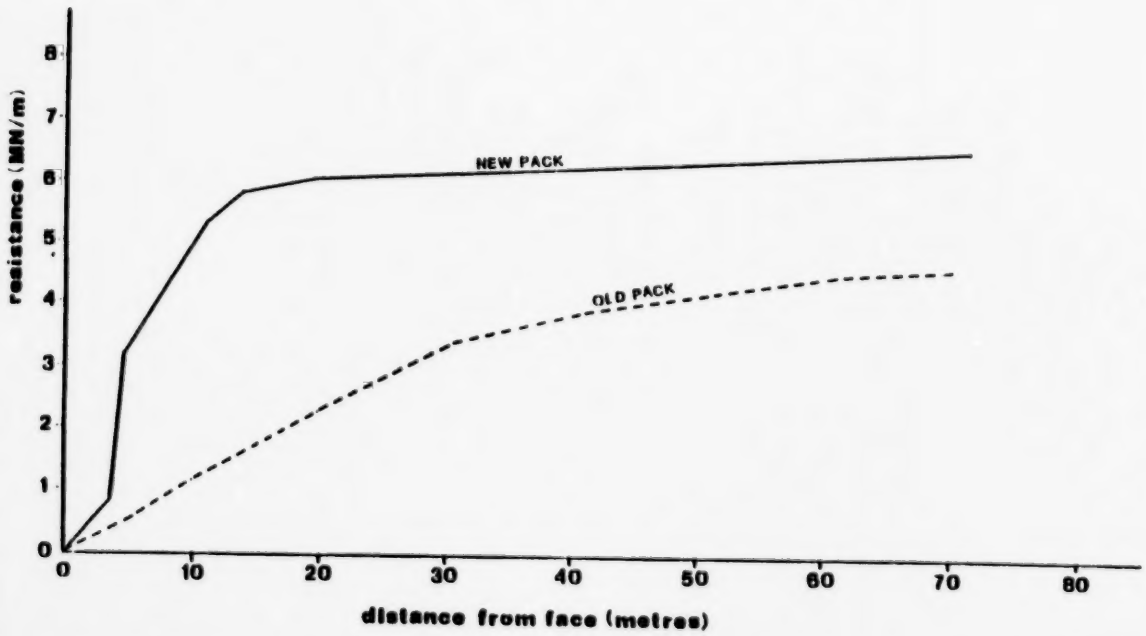

Figure 10- Pack resistance development from faceline advance

Tailgate pack is demonstrated by its slow development of resistance and its low ultimate resistance. The new pack achieves a resistance of 6.0 MN/m after 30 m of face advance, offering a more controlled closure in the gate-road. The new system was less labour intensive, quicker and cleaner than the old system.

RECOMMENDATIONS

A site should be installed to evaluate the effect of not undercutting the coal in the archway on the rib side or a new pack design for the coal rib.

Another site should be installed in the 9E Tailgate to confirm the results.

ACKNOWLEDGEMENTS

The author acknowledges the Cape Breton Development Corporation geological staff, management and workmen at Lingan Colliery for their assistance during the investigation period.

Particular thanks to Mr. W.D. Gallant, Mr. L.S. O'Leary and Mr. D.J. O'Brien for their assistance with underground monitoring. Also thanks to Dr. P. Cain for his help in preparing this report.